

به نام پروردگار یکتا



AIRPLANE DESIGN I

Lecturer: Dr. H. Alisadeghi

Fall 2020

References

1. Roskam J. , Airplane Design: Part I, to VIII
2. Raymer, Daniel P., Aircraft Design: A Conceptual Approach
3. Torenbeek, E., Synthesis of Subsonic Airplane Design: An Introduction to the Preliminary Design of Subsonic General Aviation and Transport Aircraft, with Emphasis on Layout, Aerodynamic Design, Propulsion and Performance.
4. Sforza, Pasquale M., Commercial Airplane Design Principles
5. Gudmundsson, S., General Aviation Aircraft Design: Applied Methods and Procedures.
6. Stinton, D., The Design of the Aeroplane.

Aircraft Conceptual Design Software

1. A.A.A (for Windows)

- Developed in University of Kansas
- Based on “Airplane Design” Part I ~ Part VII.



Design, Analysis and Research Corporation

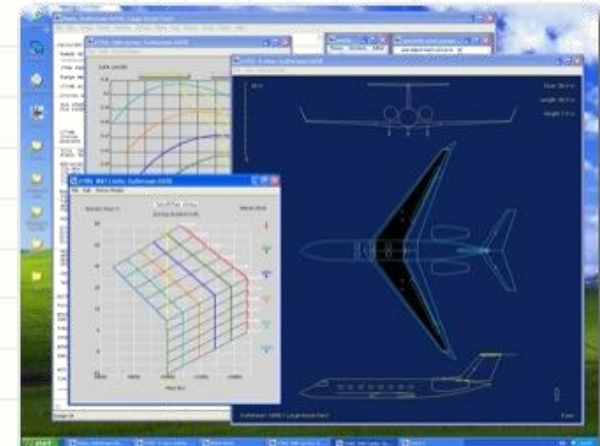
2. RDS-Student (DOS program)

- Based on “Aircraft Design: A Conceptual approach”
- Suitable for fighter aircraft design.



3. Piano for Windows

- Suitable for commercial aircraft design.
- Plenty of data.



Roskam Method

Part I: Preliminary Sizing of Airplanes (1985)

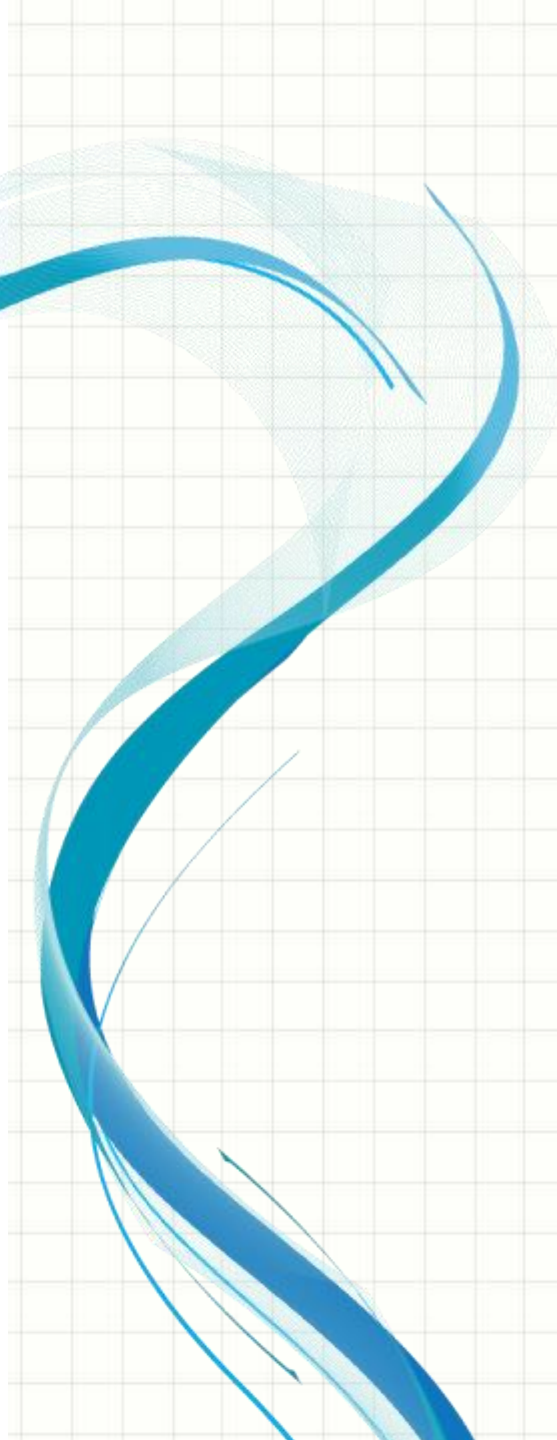
Part II: Preliminary Configuration Design and Integration of the Propulsion System (1985)

Part III: Layout Design of Cockpit, Fuselage, Wing and Empennage: Cutaways and Inboard Profiles (1986)

Part IV: Layout of Landing Gear and Systems (1986)



Dr. Jan Roskam



Roskam Method

Part V: Component Weight Estimation (1985)

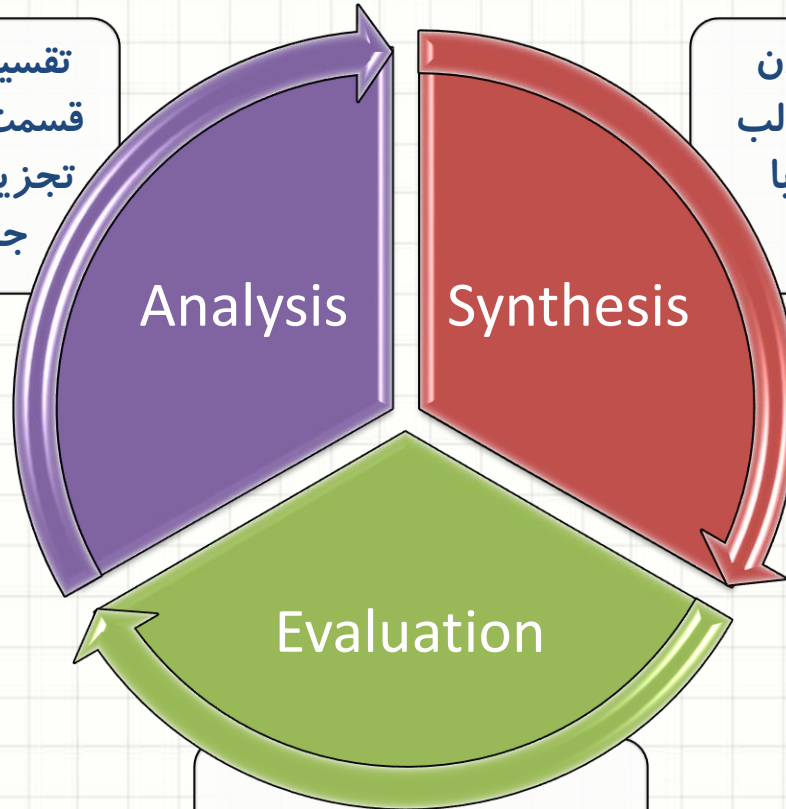
Part VI: Preliminary Calculation of Aerodynamic, Thrust and Power Characteristics (1987)

Part VII: Determination of Stability, Control and Performance Characteristics: FAR and Military Requirements (1986)

Part VIII: Airplane Cost Estimation: Design, Development, Manufacturing and Operating (1990)

Design

تقسیم مسأله و طرح به
قسمت های کوچک قابل
تجزیه و تحلیل با نقشی
جداگانه و مستقل



تلفیق و سرهم کردن
اجزای مختلف در قالب
مجموعه ای واحد با
مأموریت واحد

ارزیابی و صحت سنجی
طرح در تأمین الزامات و
نیازمندی های طراحی

1

- Conceptual Design

2

- Preliminary Design

3

- Detailed Design

Conceptual Design

(Many Solution Candidates)

- Develop project plan
- Brainstorm solutions
- Sketch designs
- Select candidates for further analysis

Preliminary Design

(Fewer Solution Candidates)

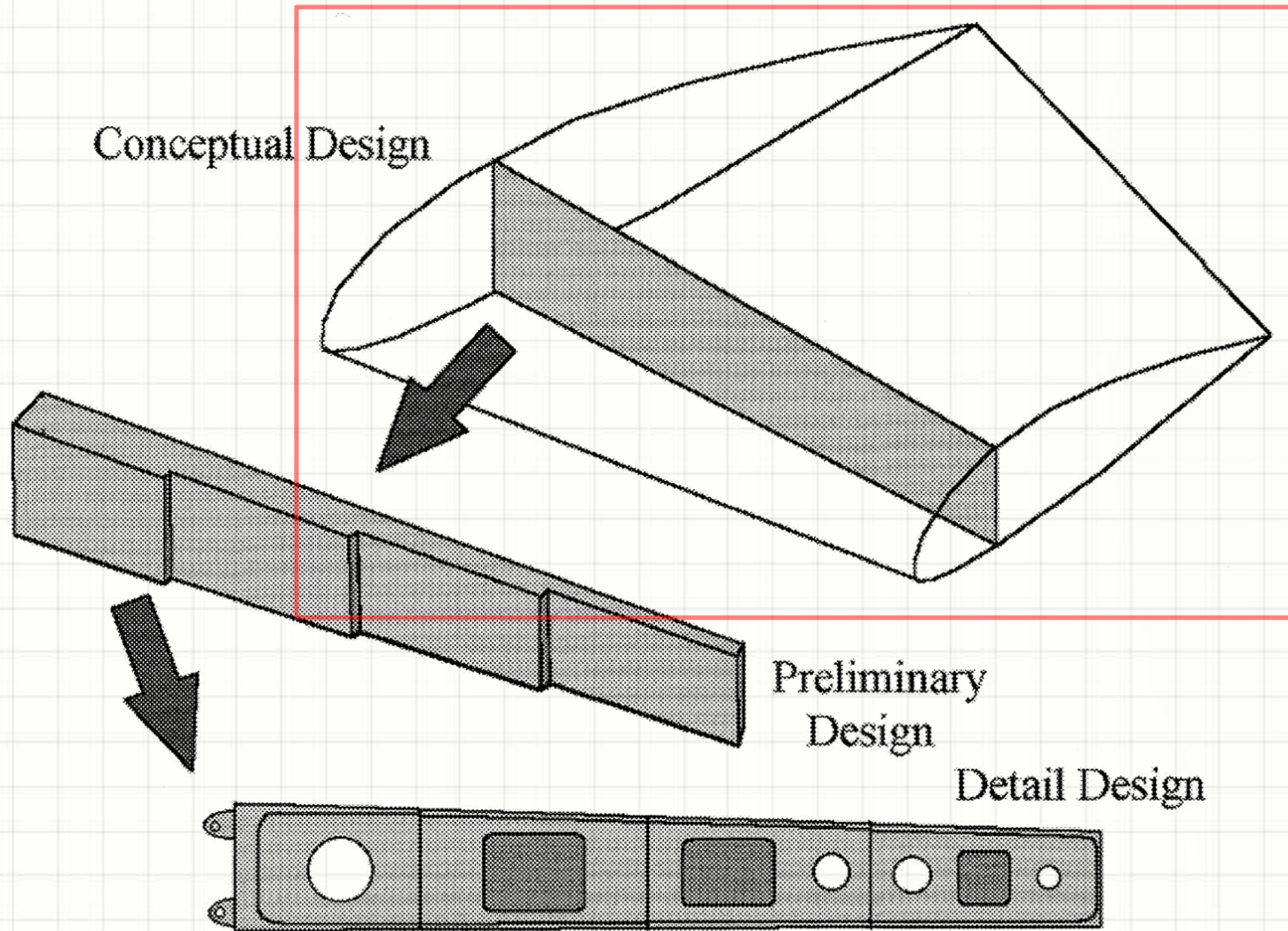
- Explore and constrain candidates
- Select airfoils
- Perform lower-order structural analyses
- Perform low-order aerodynamic analyses
- Perform analyses to evaluate candidates against the Objective Function
- Down select candidates based on analyses

Detailed Design

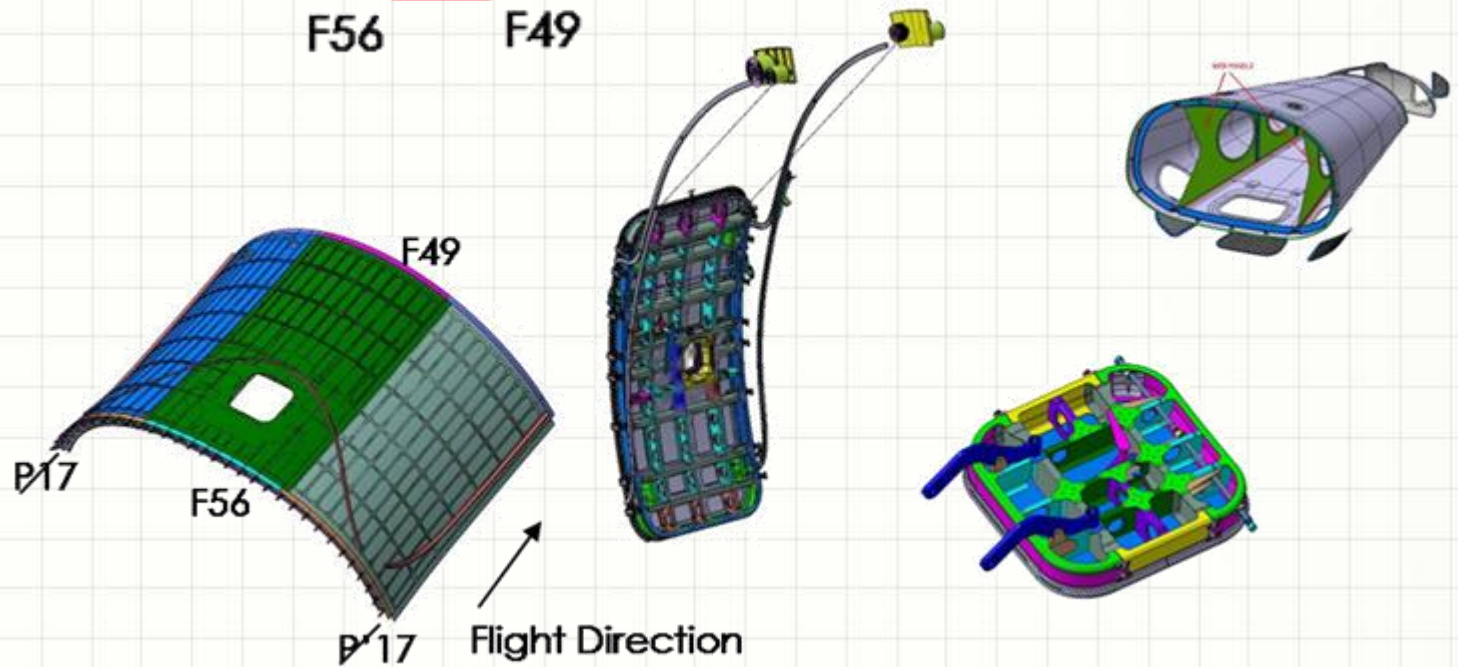
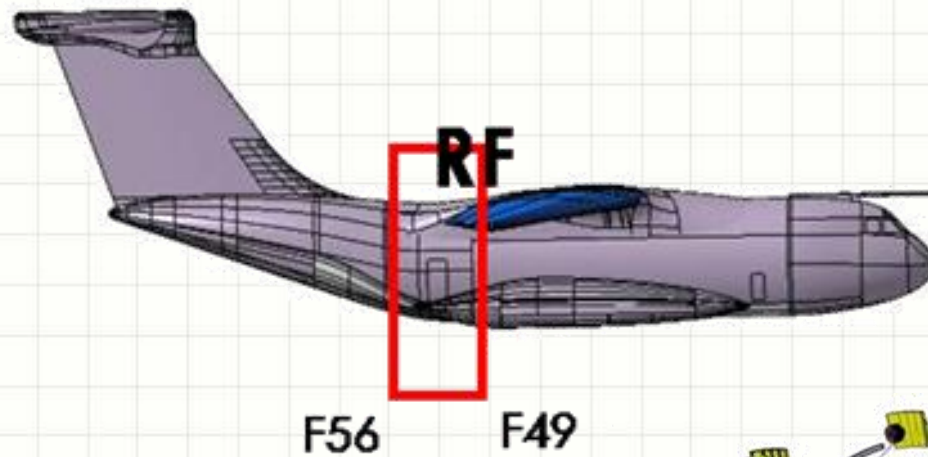
(One solution Candidate)

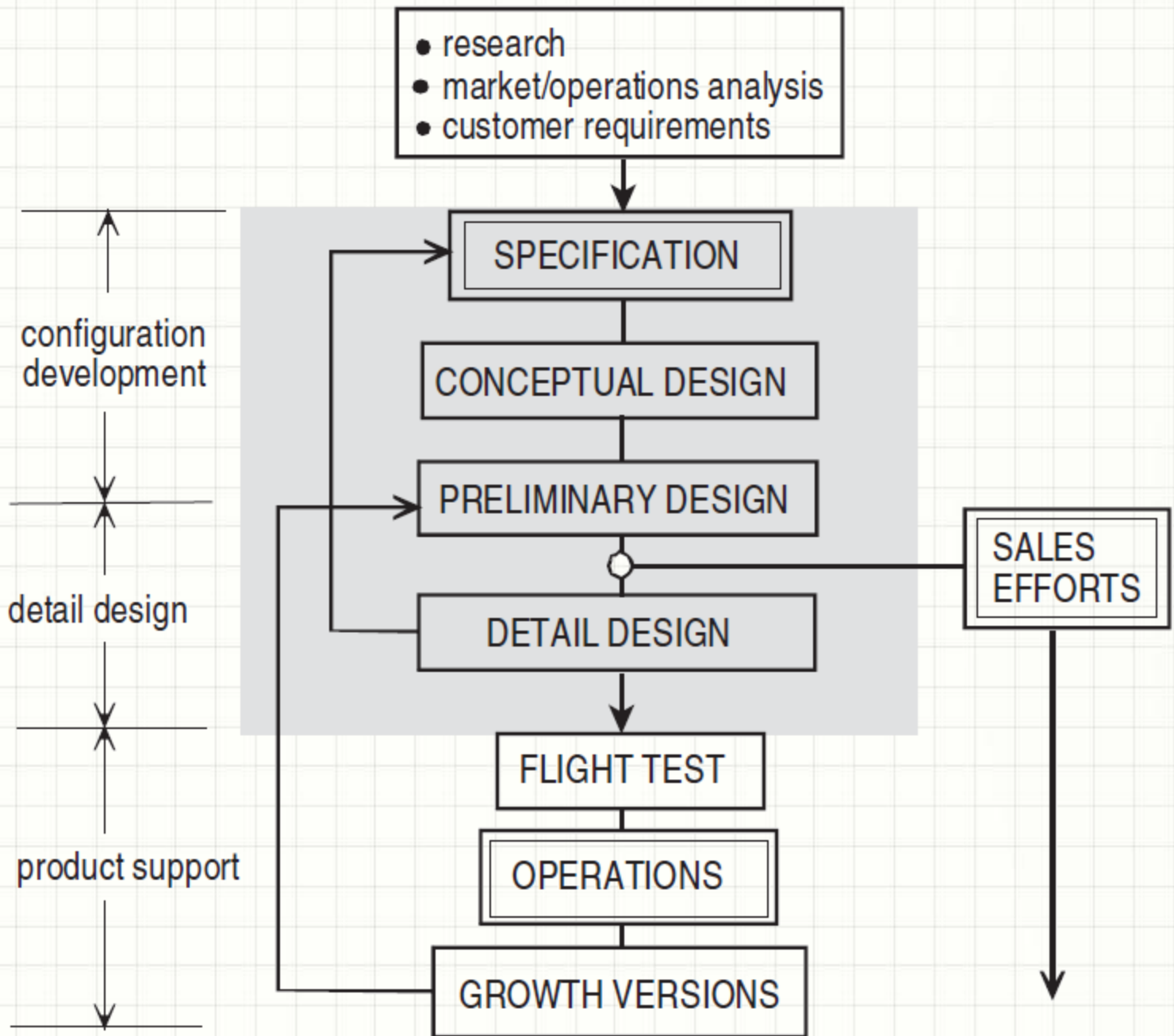
- Use higher order analyses to refine candidate (aerodynamics, structural, and load)
- Perform analyses to evaluate against Objective Function

Three Phases of Aircraft Design

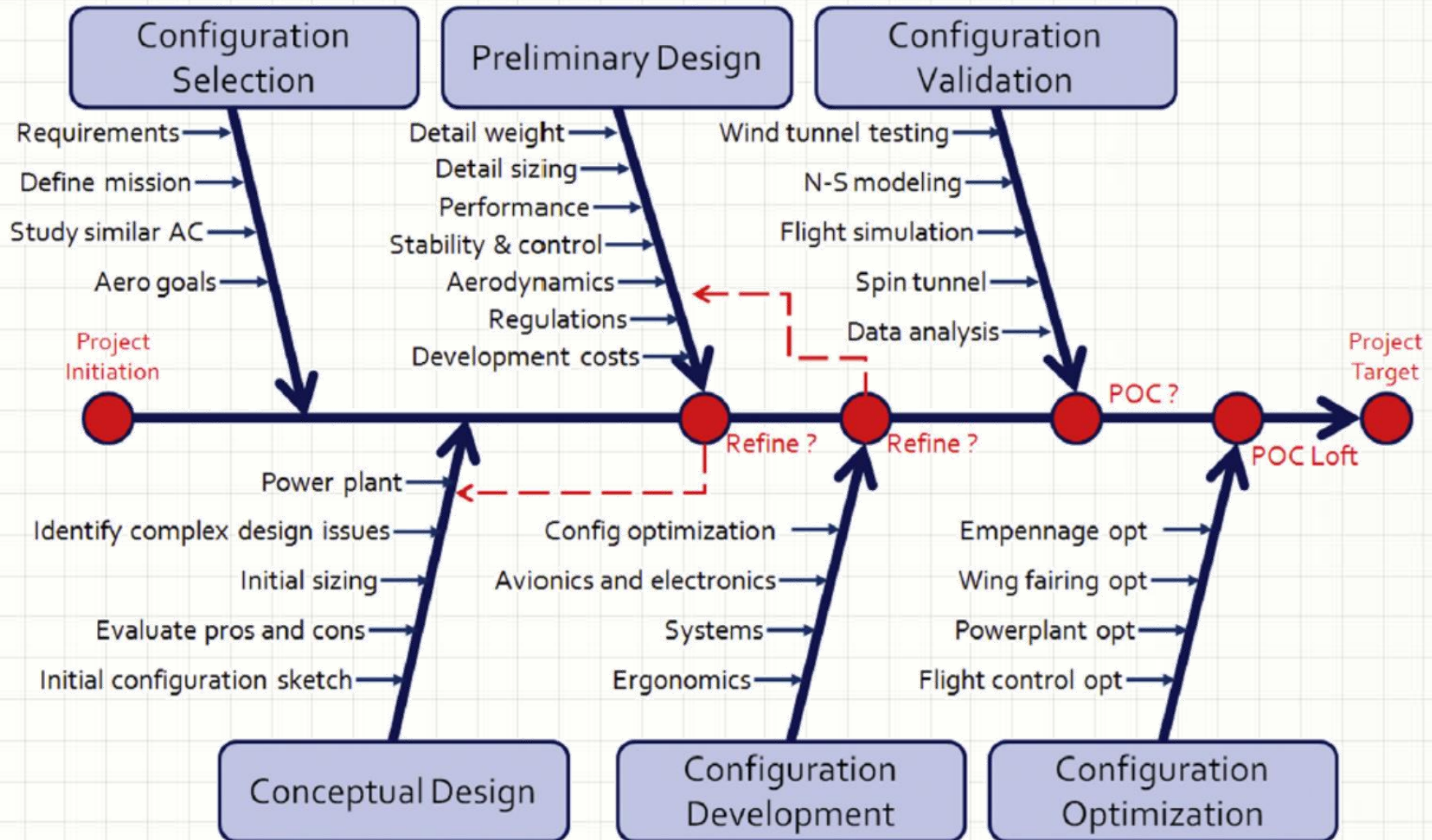


Detailed Design

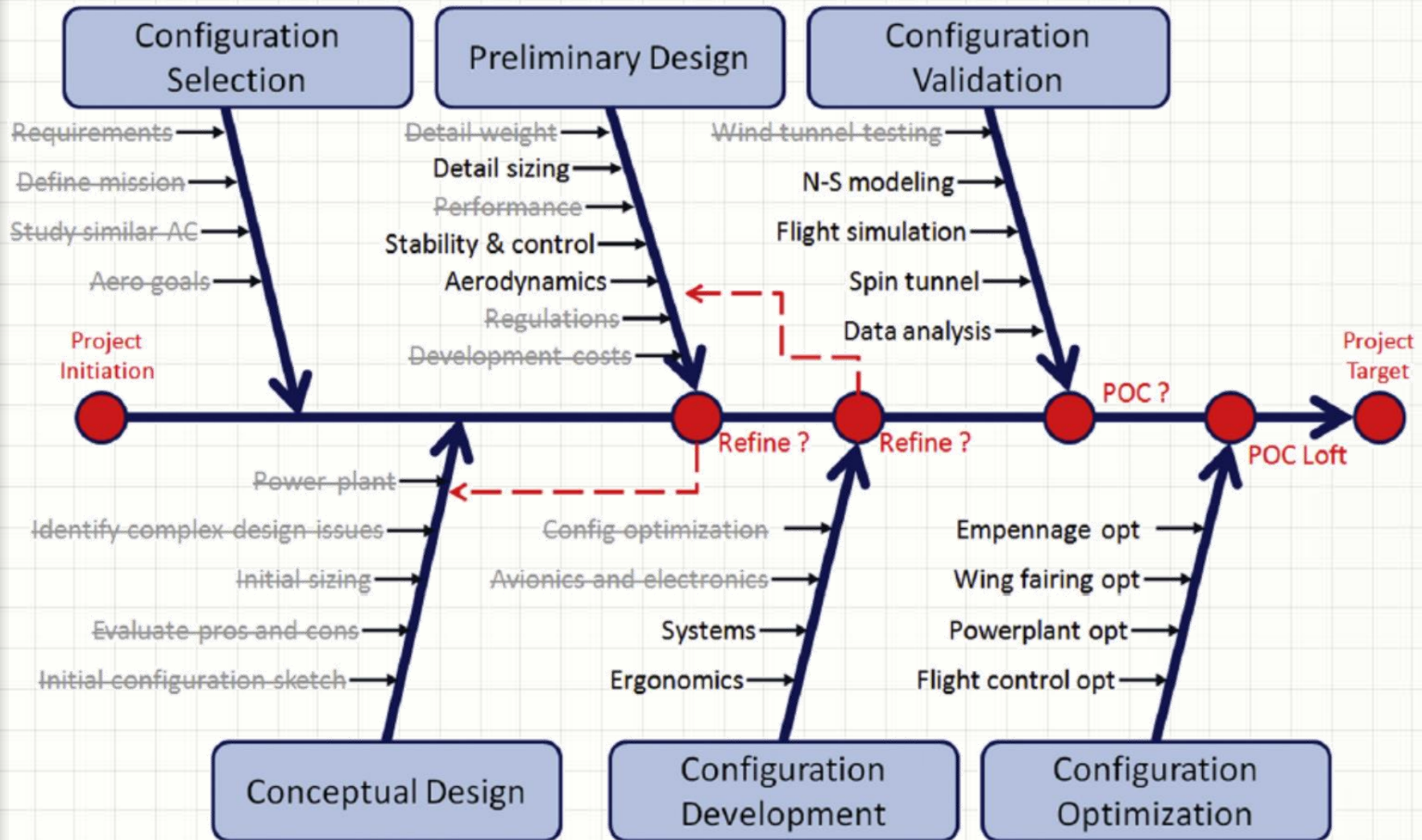




A Typical Fishbone Diagram



Cont.



(Requirement)

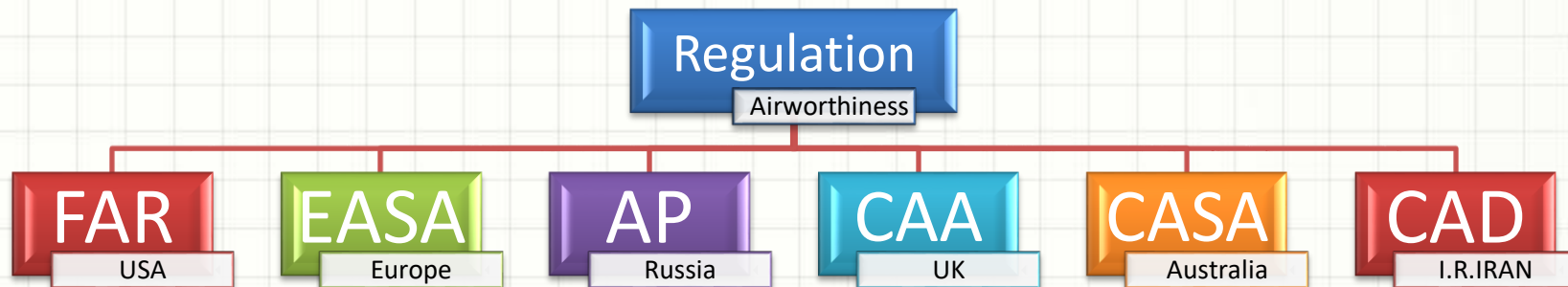
قوانینی که بهتر است انجام شوند

(Regulation)

قوانینی که حتماً باید اجرا شوند

Regulation:

FAR: Federal Aviation Regulations EASA: European Aviation Safety Agency



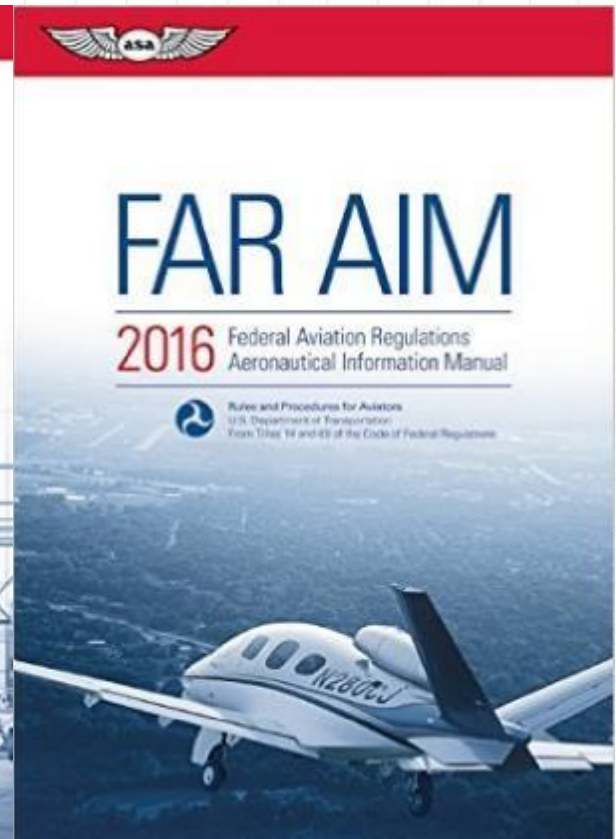
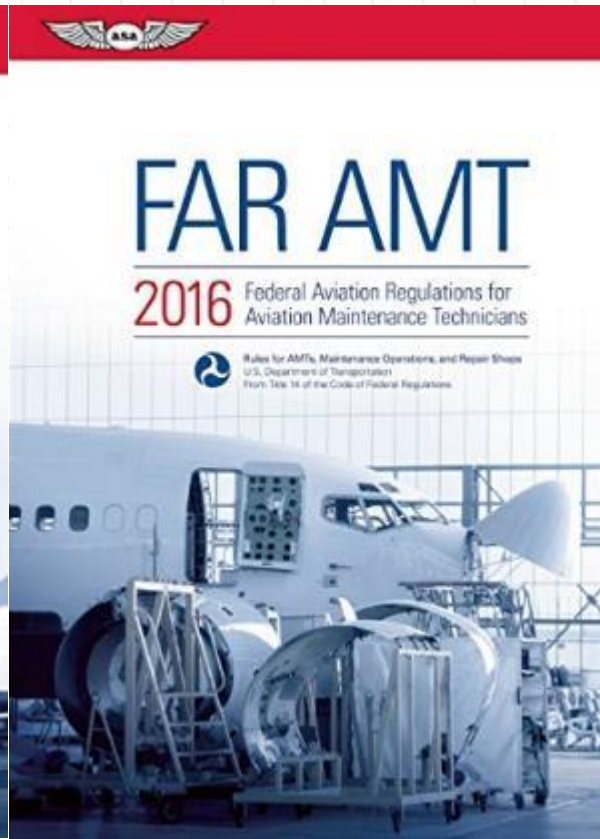
FAA: اداره هوانوردی فدرال، دایره ای از واحد ترابری و حمل و نقل ایالات متحده آمریکا می باشد که اختیار کنترل و سرپرستی همه امور هوانوردی غیر نظامی در آمریکا را به عهده دارد. اداره هوانوردی فدرال اجازه نامه های ملی پرواز را صادر می کند.



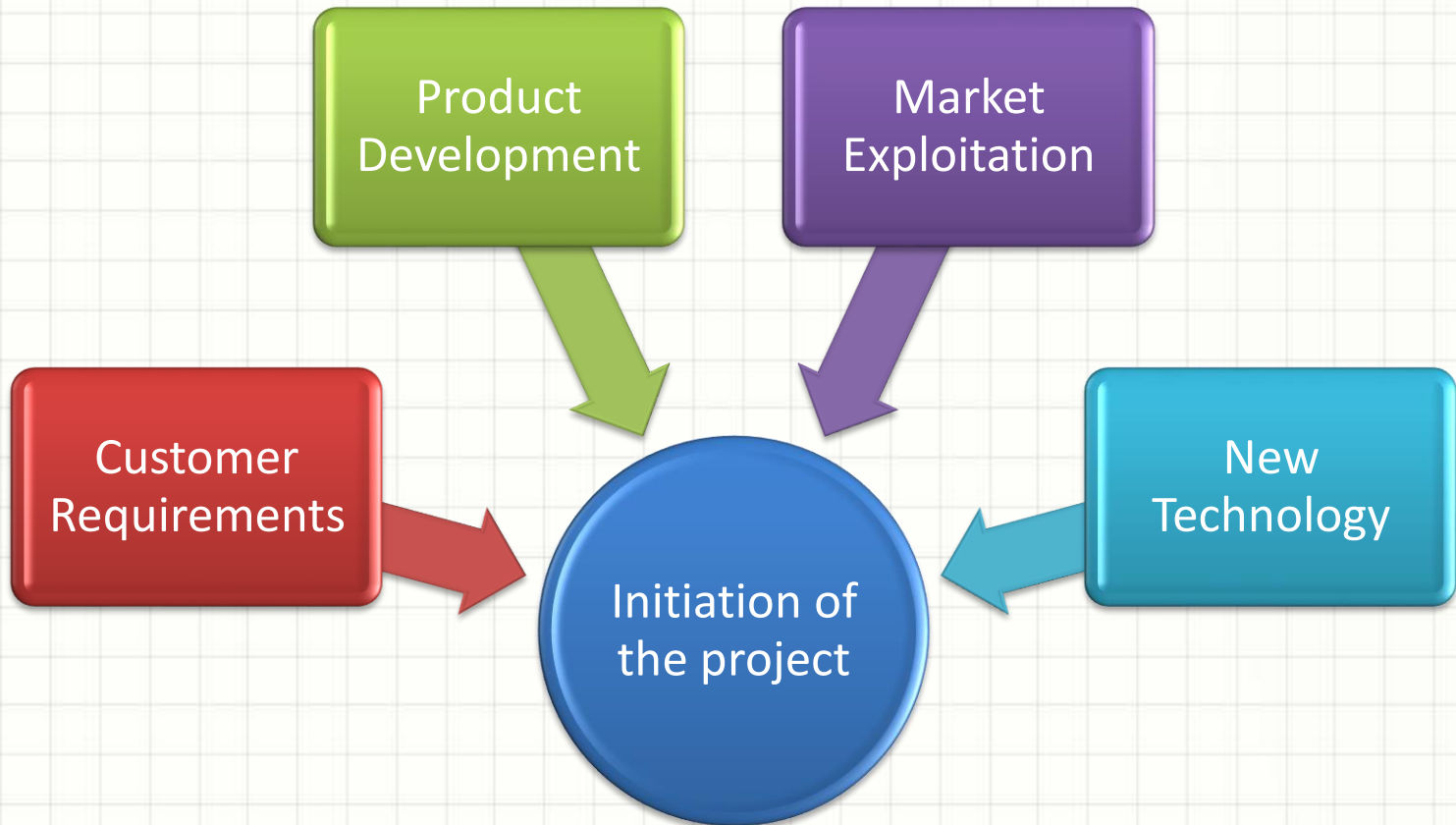
EASA
European Aviation Safety Agency

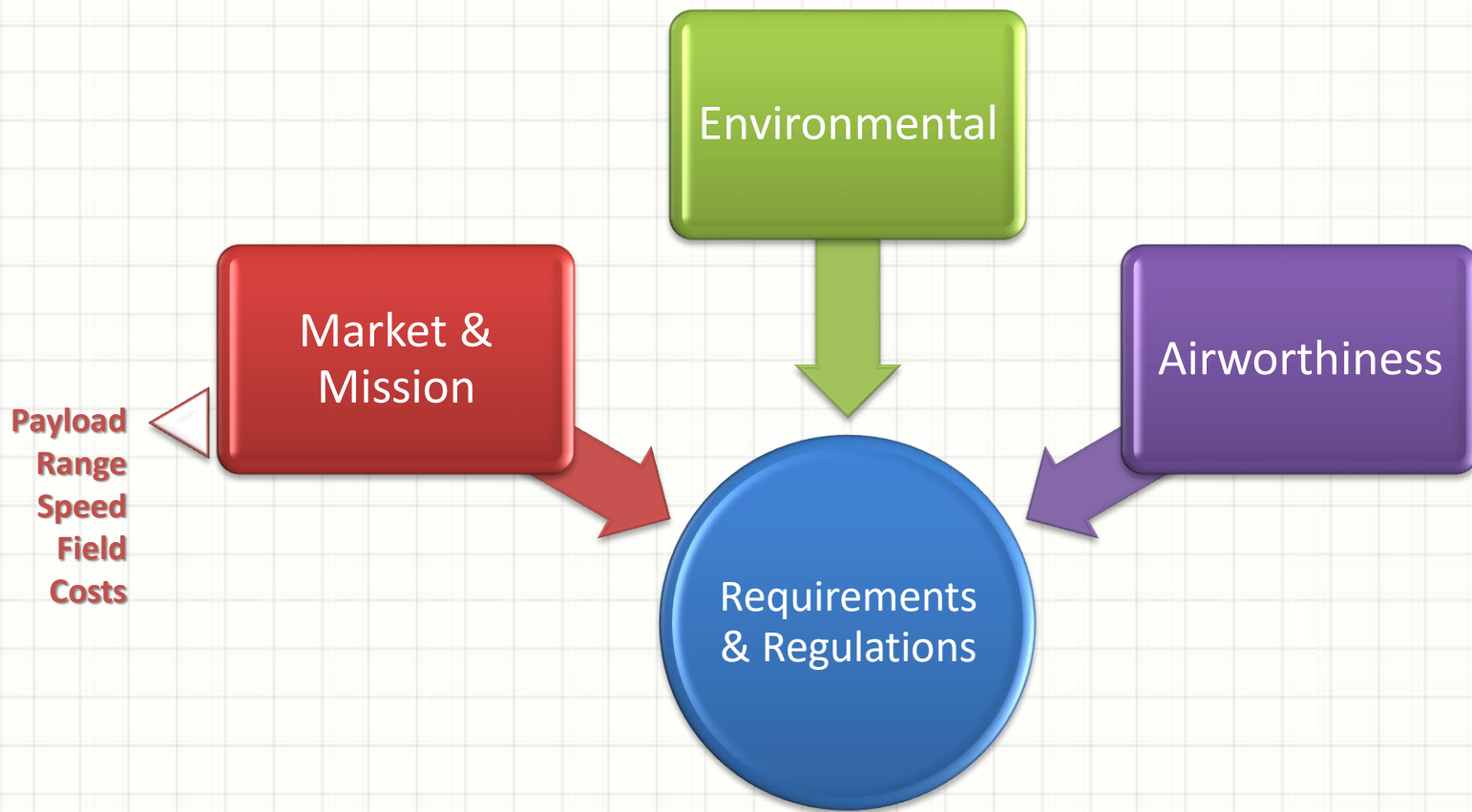


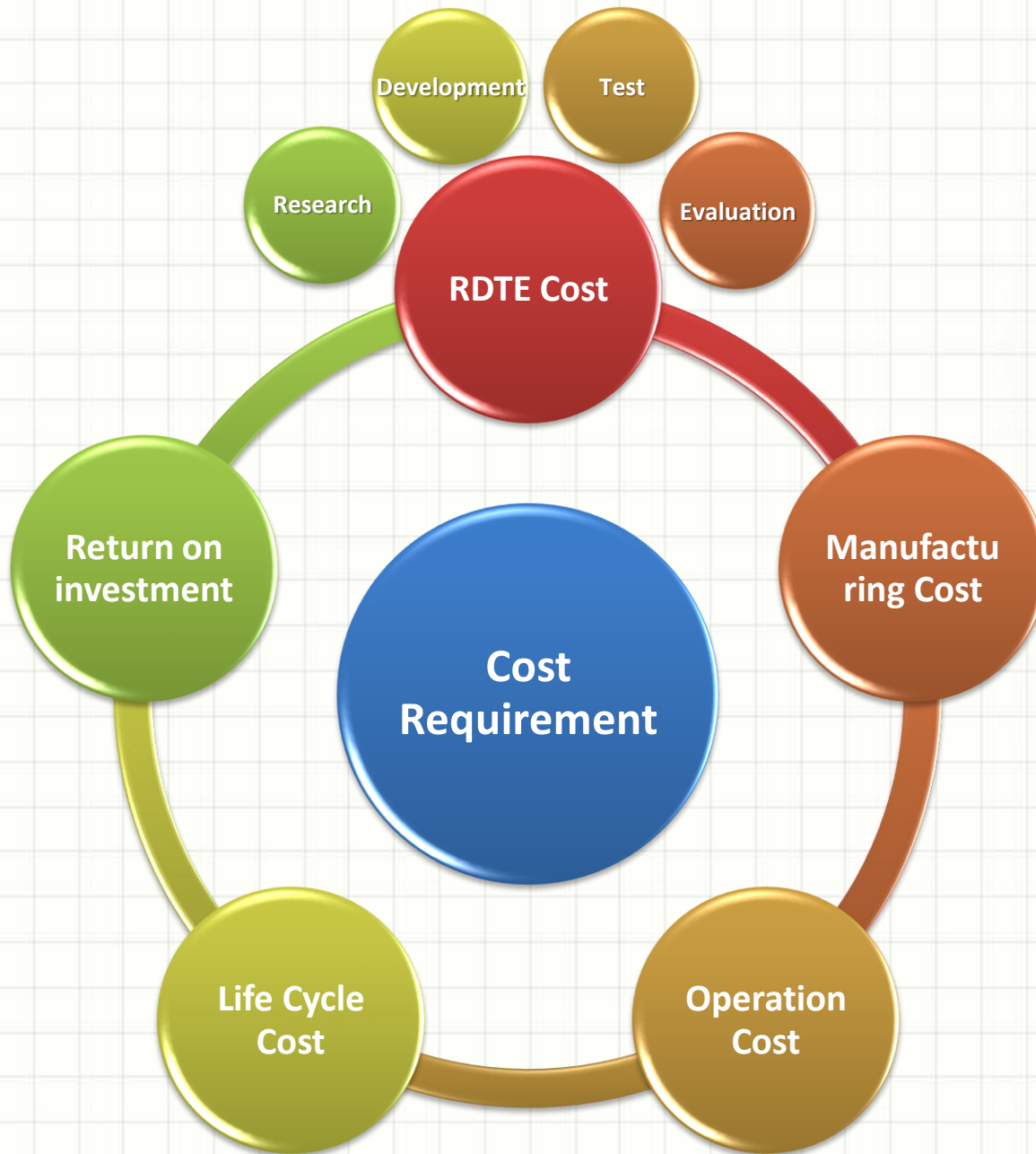
FAR (FEDERAL AVIATION REGULATIONS)

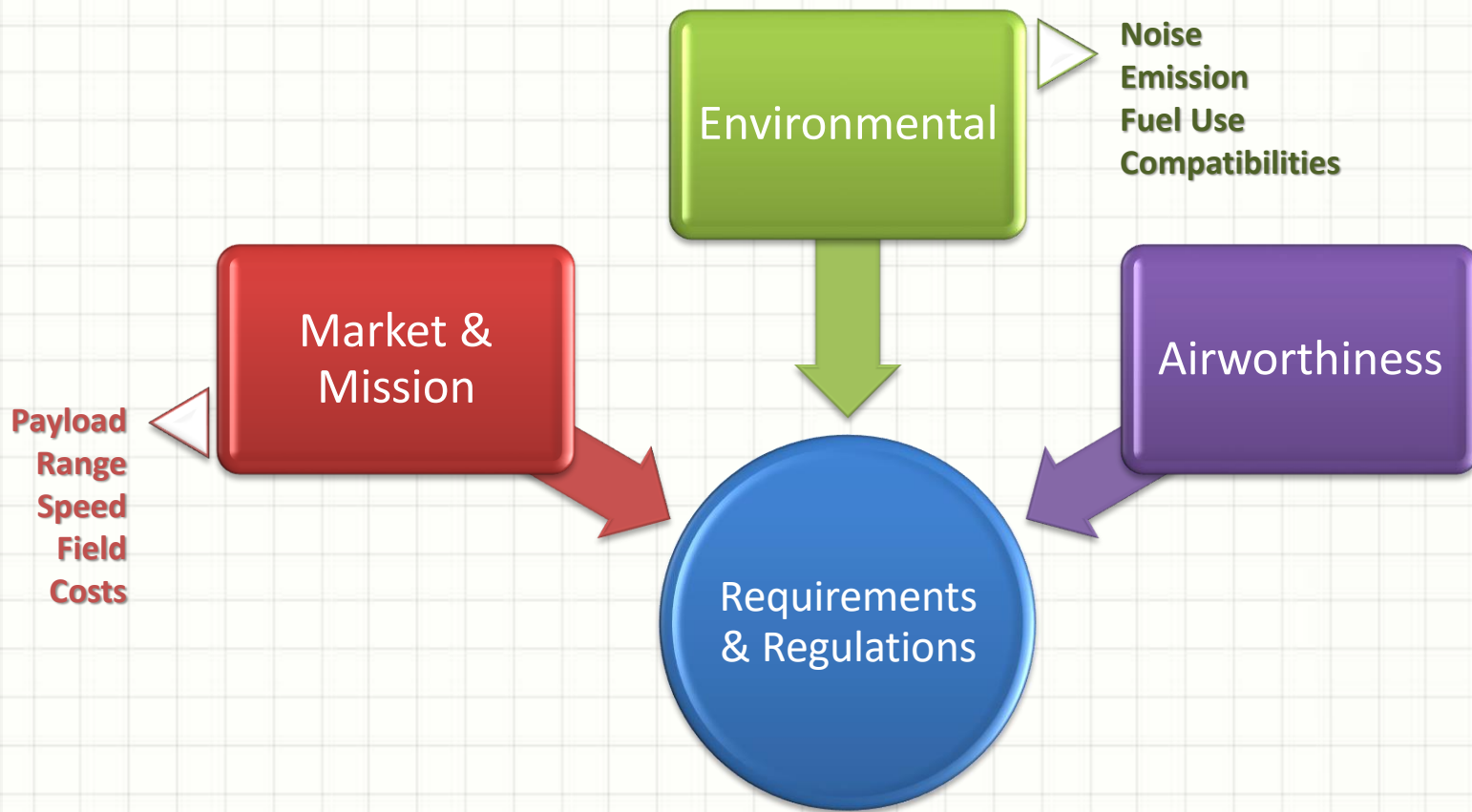


Conceptual Design Procedure

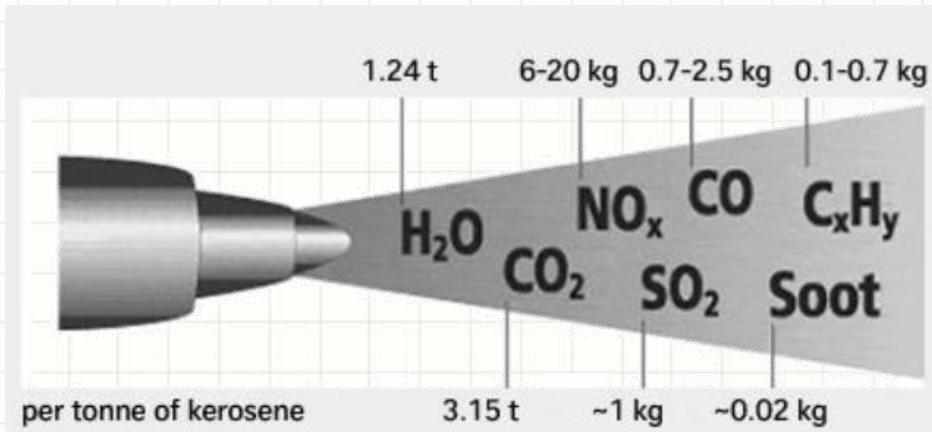
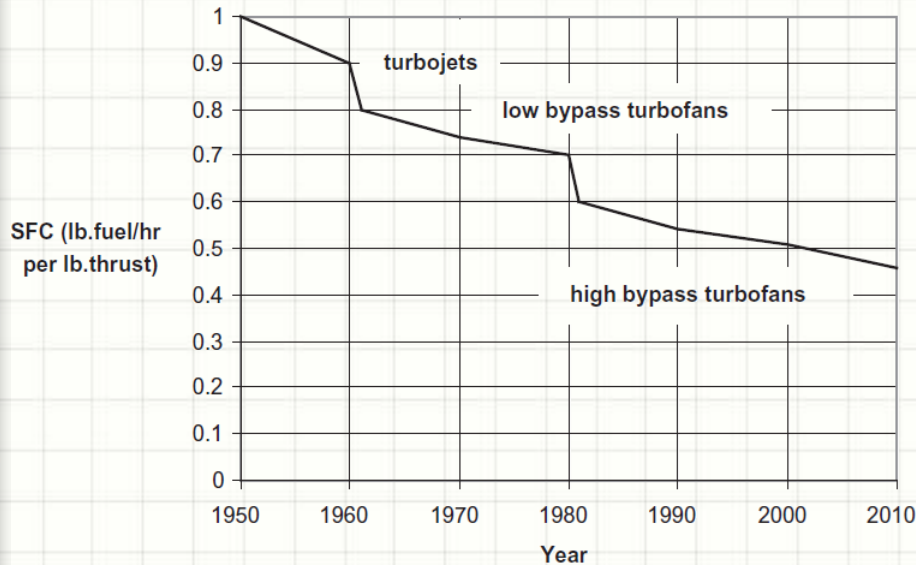




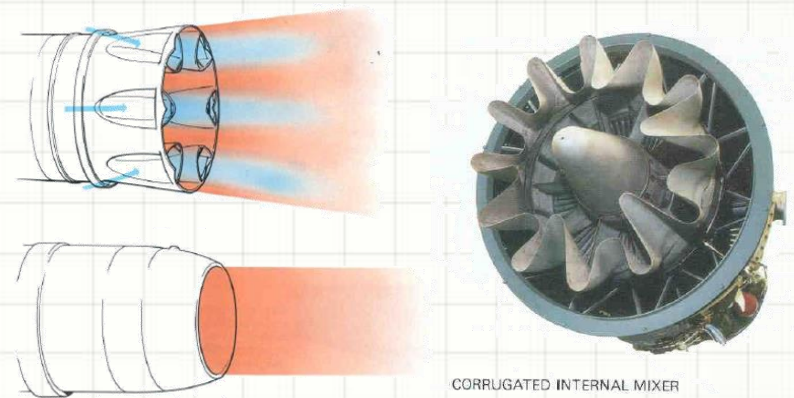
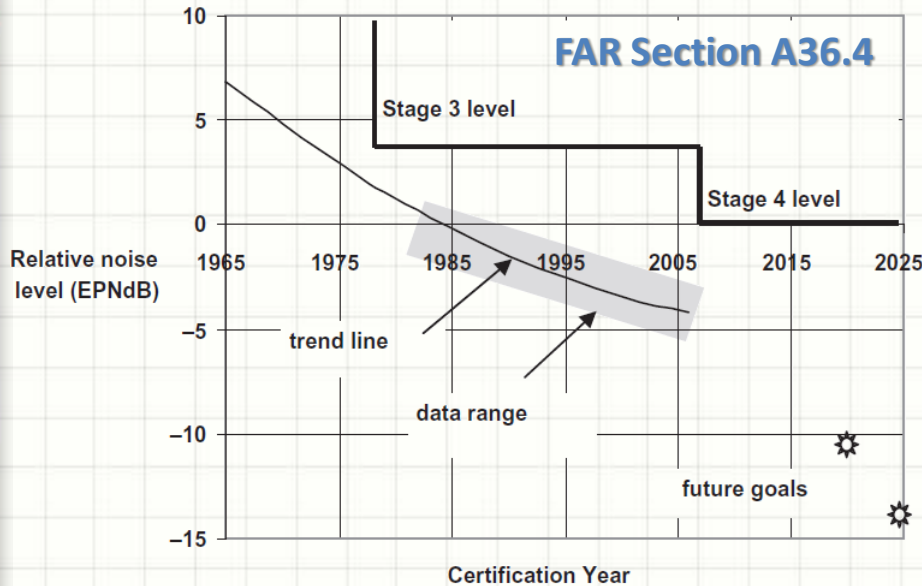
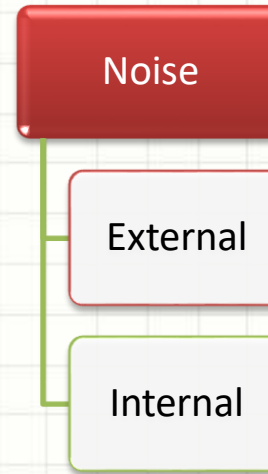
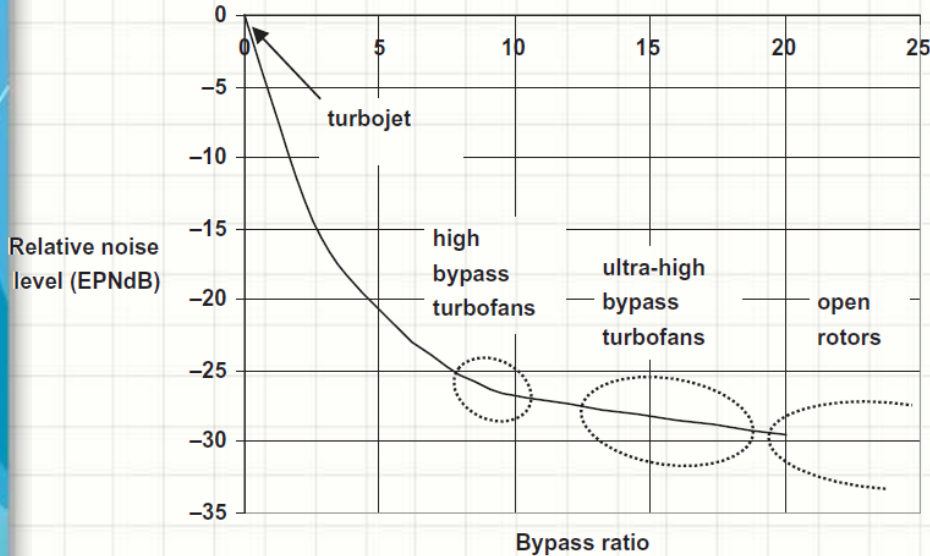




Environmental Considerations



Environmental Considerations

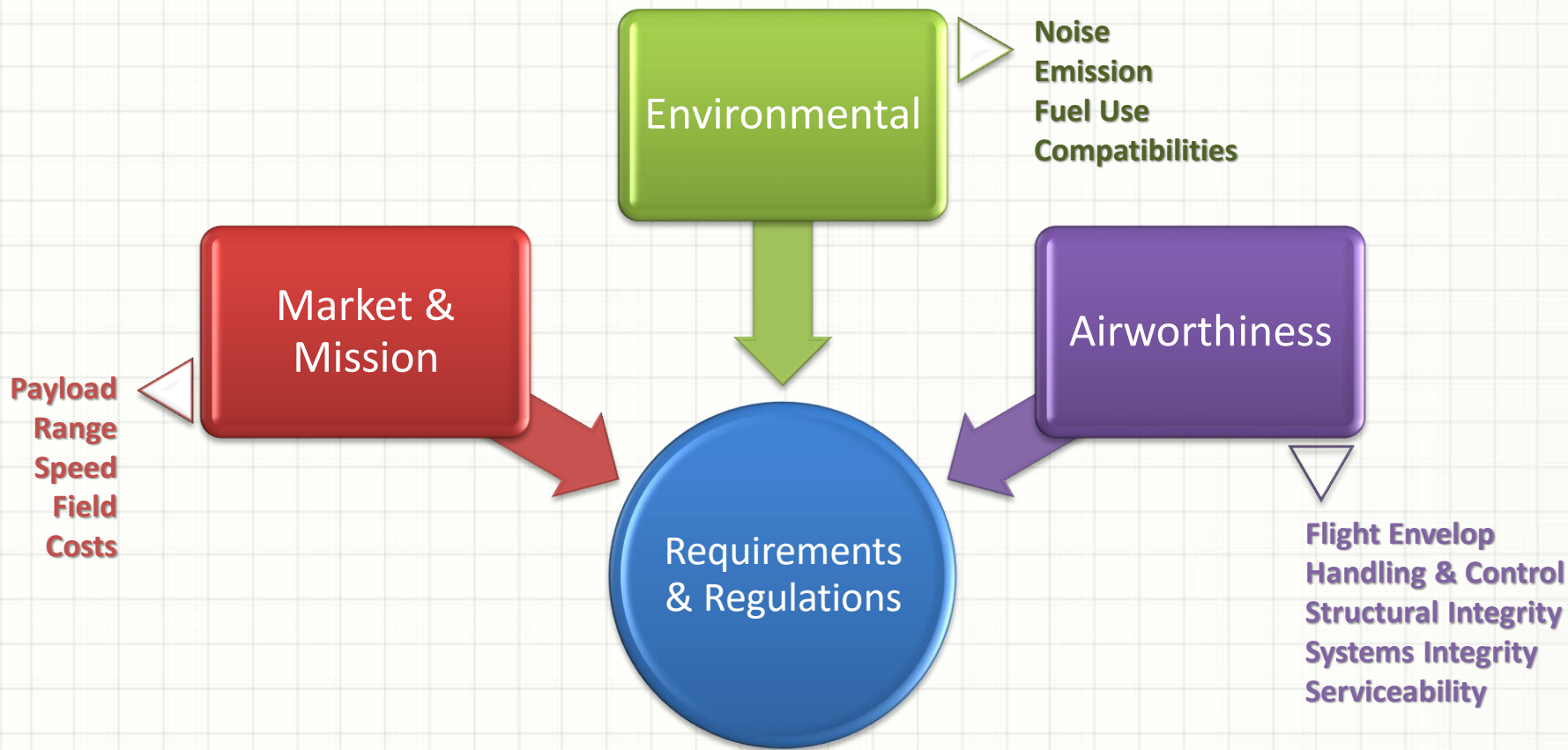


EPN: Effective perceived noise

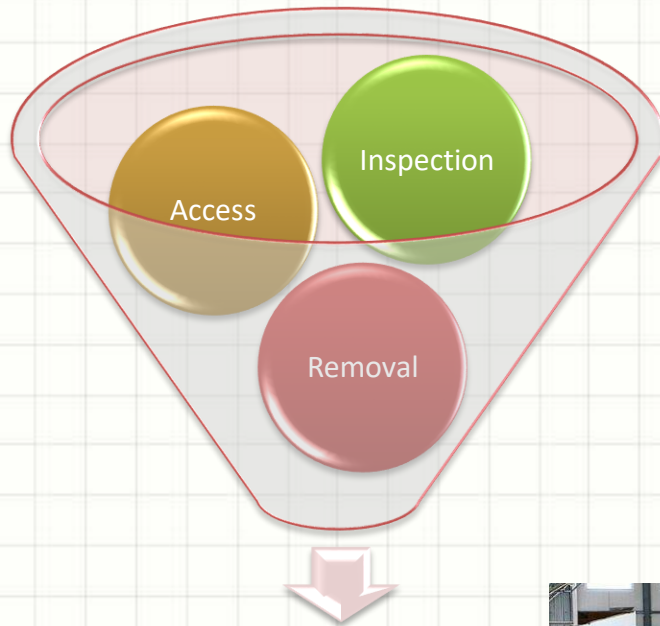
Environmental Considerations



The **Boeing 2707** was the first American supersonic transport (SST) project



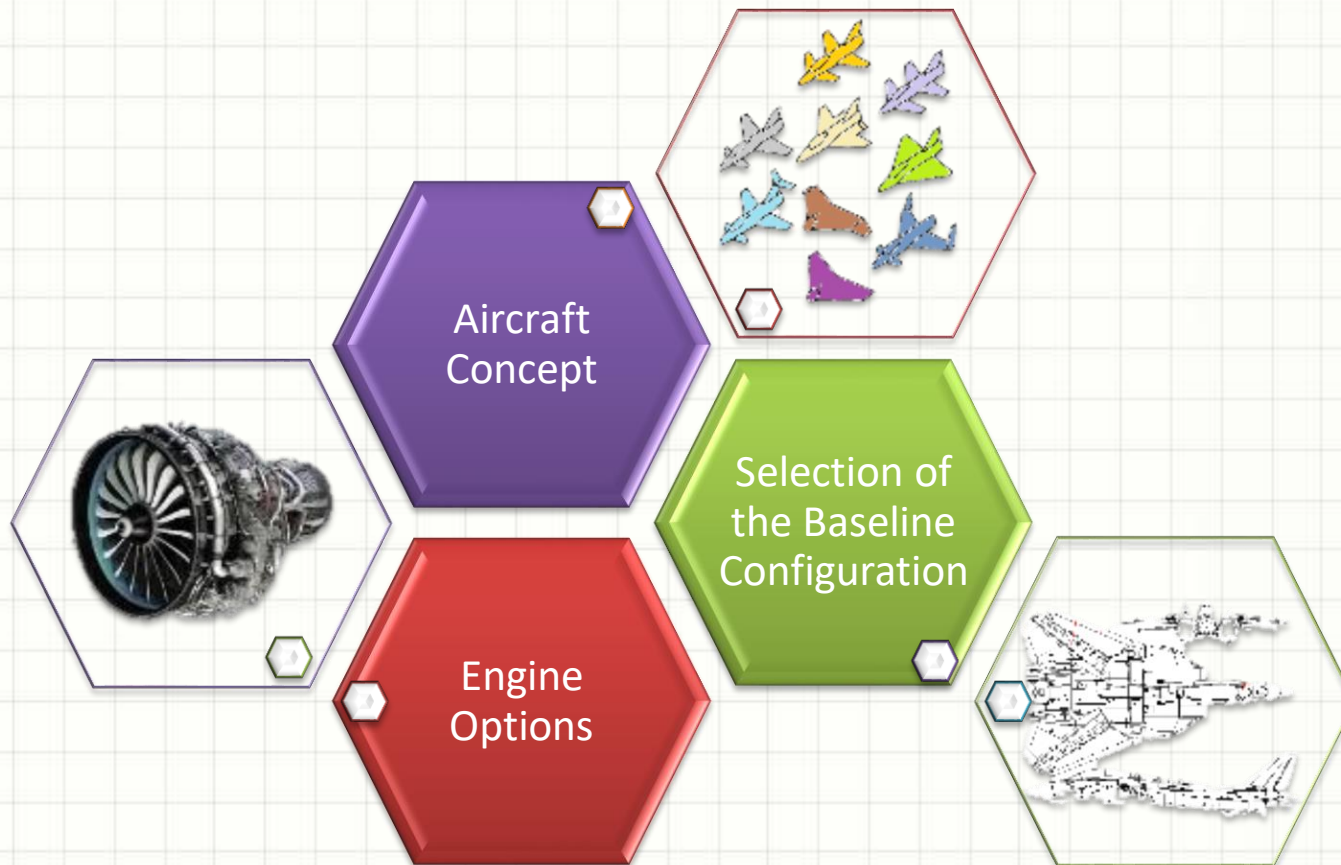
Maintenance Considerations



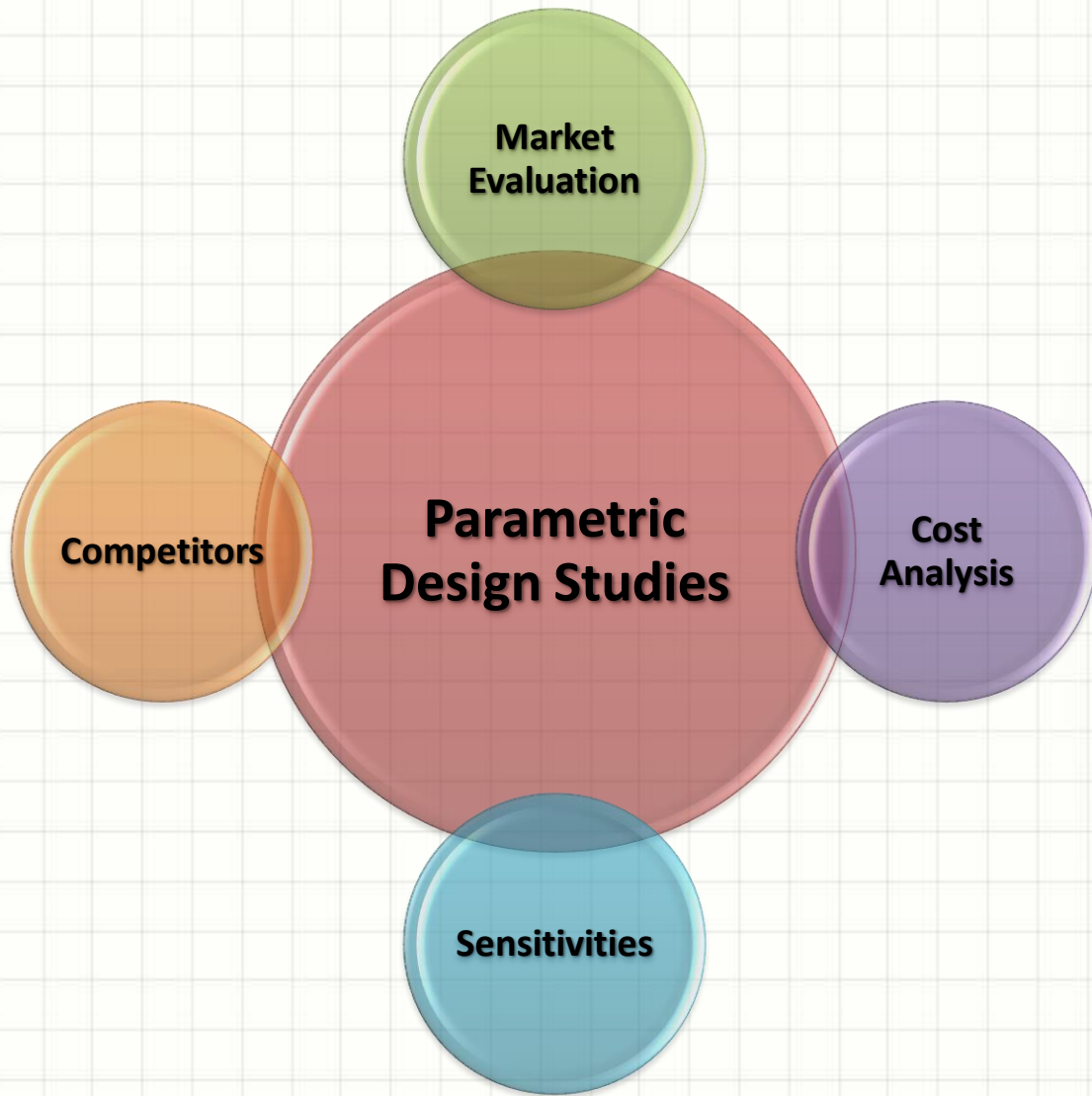
Maintenance



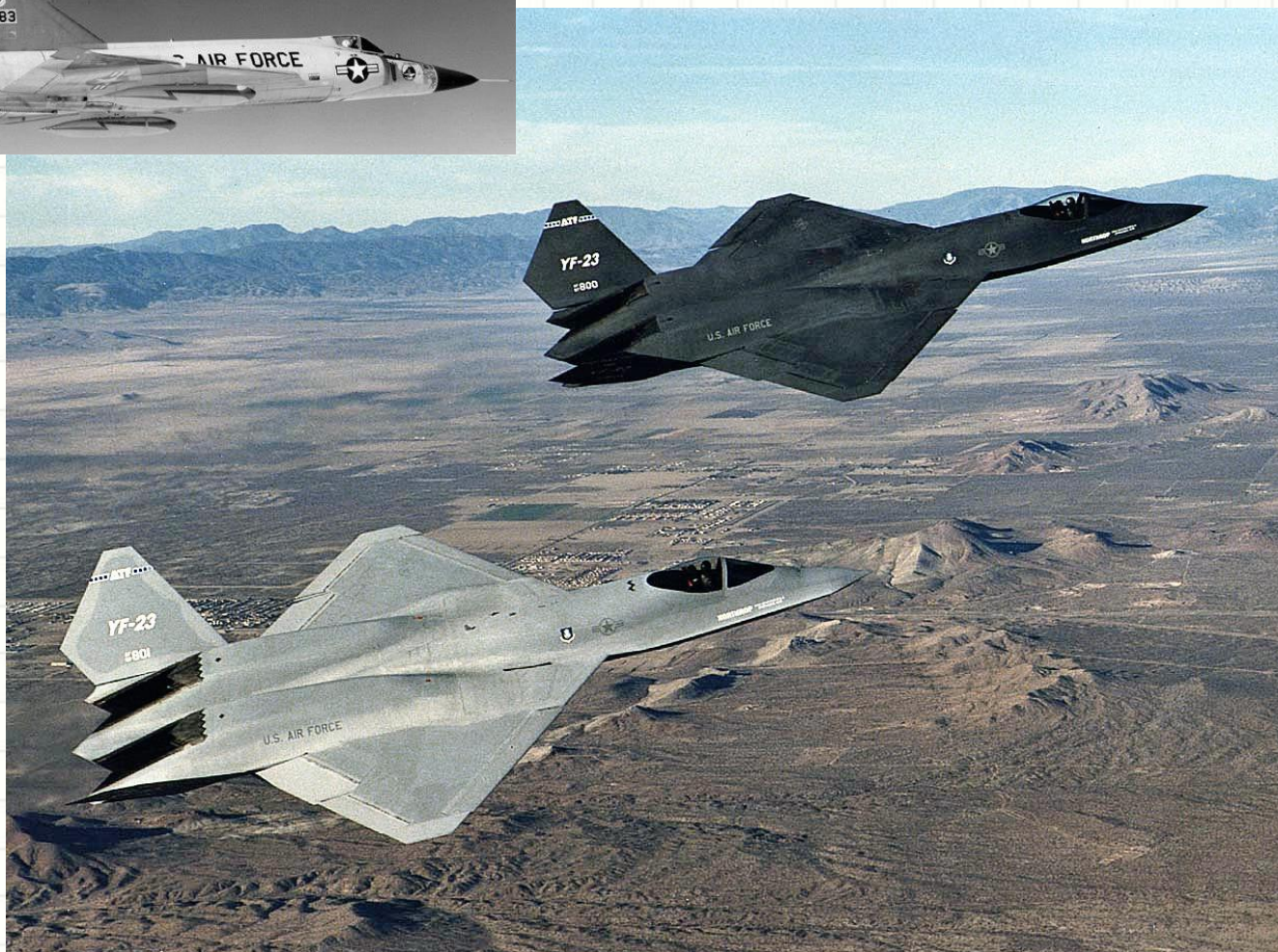








نتیجه فاز **RDTE** منجر به تولید نمونه‌های اولیه هواپیما (**Prototype**) می‌گردد. تعداد نمونه‌ها ممکن است به بیش از ۶ الی ۱۰ نمونه برسد.
(بیشترین نمونه اولیه مربوط به هواپیما **F-102A** به تعداد ۵۲ نمونه اولیه!!!)



Two Northrop/McDonnell Douglas **YF-23** Prototypes

در مرحله تست، بیش از ۳۶۰ نوع تست با بیش از ۱۰۰۰ بار تکرار بر روی هواپیما انجام می‌گیرد.





QUESTION?